DOCUMENT RESUME

ED 195 812 CE 027 536

AUTHOR Colliver, Jewell B.
TITLE Dairy Housing and Equipment. A Unit for Teachers of Vocational Agriculture. Production Agriculture Curriculum Materials Project.
INSTITUTION Kentucky Univ., Lexington. Div. of Vocational Education.
SPONS AGENCY Kentucky Research Coordinating Unit, Lexington.
REPORT NO H-S-51Aa
PUB DATE 79
NOTE 32p.: For related documents see CE 027 535-540.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Agricultural Education; *Agricultural Machinery; *Agricultural Production; *Agricultural Skills; *Animal Facilities; Behavioral Objectives; Competence; Equipment Evaluation; Equipment Maintenance; Instructional Materials; Job Skills; Learning Activities; Livestock; Secondary Education; *Vocational Education
IDENTIFIERS *Dairy Industry

ABSTRACT

Designed to provide instructional materials for use by vocational agriculture teachers, this unit on dairy housing and equipment contains four lessons based upon competencies needed to be a dairy farmer. The lessons in this unit cover the maintenance of milking systems, the provision of adequate and economical housing for dairy animals, and the provision of adequate and economical materials-handling equipment. Each lesson contains the following: (1) a performance objective, (2) teaching-learning activities (including technical content), (3) supplementary materials (lists of references), and (4) check-out activities. Suggestions for using problem-solving procedures, resource persons, field trips, and audio-visual aids are outlined in the sections on teaching-learning activities provided for each lesson. (Related documents contain similar instructional materials on breeding livestock, livestock judging, feeding livestock, tobacco production, and corn production--see note.) (MN)

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# DAIRY HOUSING AND EQUIPMENT

A Unit for Teachers of Vocational Agriculture

Developed by:

Jewell B. Colliver
Teacher of Vocational Agriculture
Barren County High School
Glasgow, Kentucky

Supervised by:

Rodney W. Tulloch
Associate Professor and Project Director
University of Kentucky

CE 027 536

Sponsored by:

Research Coordinating Unit
Bureau of Vocational Education
Kentucky Department of Education

1979

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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ACKNOWLEDGEMENTS

We are grateful to the following people for their contributions in completing this unit: Phyliss Dedman, for secretarial service; Sheila Onkst, typing; Pat Schrader and Judy Levine, editing; Gladys Owens, art work; Gary Lane, Animal Science Department, who reviewed the unit for technical content; and each of the teacher/writers who reviewed the unit.

Gratitude also goes to Lou Perry, Robert Kelley, Jewell Deene Ellis, Steve Davis, Melissa Briscoe, and Charles Wade of the Bureau of Vocational Education, State Department of Education; and Harold Binkley, Herbert Bruce, Chalres Byers, and John Dickens of the Department of Vocational Education, University of Kentucky, as well as all the joint State Staff in Agricultural Education for their support throughout the development of this and other units for teachers of vocational agriculture.

We also wish to thank the many writers, publishers, and governmental agencies who furnished materials and references for use in the project.

# DAIRY HOUSING AND EQUIPMENT

Number of Class Periods _____ Month(s) _____

## INTRODUCTION

The dairy industry is very complex, and because of the great investment required to start into the business, careful planning and management are necessary. This is especially true in selection and maintenance of housing and equipment, since once selected it is usually used for several years. Careful maintenance of housing and equipment can mean the difference between profit and loss.

Lessons found in this unit are based upon competencies needed to be a dairy farmer and are adapted from the National Agricultural Occupations Competency Study. They are as follows:

1. Maintaining Milking Systems in Good Condition
2. Providing an Adequate and Economical Milk-Handling System
3. Providing Adequate and Economical Housing for Dairy Animals
4. Providing Adequate and Economical Materials-Handling Equipment

## DIRECTIONS

Each lesson listed is followed by: 1) a performance objective, 2) teaching-learning activities (including technical content), 3) supplementary materials (including transparency masters and lists of references), and 4) check-out activities. Since the knowledge that can be obtained in each of these lessons is necessary to be a successful dairy farmer, all the lessons should be taught unless local circumstances or previous learnings would cause this to be unnecessary. They do not necessarily need to be taught in the order listed.

1. MAINTAINING MILKING SYSTEM IN GOOD CONDITION

1.1 Performance Objective

Given two written check-out activities concerning maintaining the milking system, the student will complete the check-out with 80 percent accuracy on each activity.

1.2 Teaching-Learning Activities

a. This section on maintaining the milking system can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take a field trip to a well managed milking operation to see how equipment is maintained and operated. Give demonstrations and hands-on experience if possible.

c. Obtain the loan of milking equipment for use in the classroom. For example, worn out inflations can be used to show problems and are readily available at no cost.

d. Give demonstrations on correct procedures for properly maintaining milking systems.

e. Use resource persons such as a milk equipment dealer, extension personnel, and farmers.

1.2.1 Use milking equipment properly.

a. If mastitis is a problem, it may indicate that the milking system is not in good condition or that it is not being used properly.

b. If ends of cow's teats are injured, rosetted or cracked, it indicates improper milking procedure, equipment or possibly teat dip.

c. Observe amount of machine stripping being done. Much injury can be caused to the teat ends by excessive machine stripping and over milking.

d. Use proper milking procedure including:

(1) Providing a calm, quiet, stress-free environment for the cows.
(2) Washing and stimulating the cow's udder.
(3) Stripping fore-milk and drying with individual paper towels.
(4) Checking for mastitis.
(5) Applying milker one minute after stimulation.
(6) Adjusting milker for downward and forward milking action.
(7) Dipping teats immediately after milking.

1.2.2 Check vacuum system and keep operating at correct level.

a. If milker units fall off or squawk a lot, the vacuum system needs attention.

b. Keep the glass cover on the vacuum guage clean. After several yards, vacuum guages tend to corrode and be in error. A false reading is worse than none at all.

c. Check the vacuum regulator. It should be clean and working properly. Listen to see if it hisses and allows air in properly. If it sticks, it should be discarded.

d. Regulator should be sensitive to 15-inch vacuum fluctuation or less. Regulators should not be located in feed room or outside where they can freeze up or be covered by snow or ice.

e. Conduct the 5-3 test. Hook up units as during milking. Allow air in one of the teat cups for five seconds, then drop the teat cup to normal position. The vacuum drop should recover in three seconds. If it does not, either the vacuum pump is inadequate or the vacuum lines are too small, or a constriction may be present in the line or regulator.

f. Vacuum levels should be the same level in both the milking and pulsator lines for most equipment. Some equipment has separate vacuum systems for milking and pulsation. Current research suggests milking at 15 inches. Mercury Vacuum results in more injury to teat ends, thus causing more mastitis problems than 12.5-inch Mercury Vacuum. However, if high milkline is used, it is probably necessary to milk at 14 or 15-inch Mercury Vacuum even though more stress results on the teats. A low milk line system is desirable. Vacuum fluctuations should be kept to a minimum. Low milking lines or weigh jars are desirable. Low lines prevent surging of milk causing intermittent vacuum surges. Weigh jars provide a vacuum reserve near each cow.

g. An inefficient or undersized vacuum pump can cancel all other things done correctly in breeding, feeding and herd management. A pump should remove 10 cubic feet per minute for each milking unit.

1.2.3 Keep teat inflations in proper condition.

Many systems use a cleaned-in-place (CIP) washing system. If the system is not a CIP, the inflations should be maintained in the proper condition by:

a. Rinsing inflations immediately after use.

b. Washing inflations with alkaline detergent.

c. Rinsing inflation cleaner from inflations.

d. Washing inflations in organic acid.

e. Rinsing inflations with hot water.

f. Storing in cool dry, dark place.

g. Replacing inflations if they show signs of deterioration or lose elasticity with not more than 1,500 cow milkings between changes.

1.2.4 Use proper cleaning and sanitizing techniques.

a. The importance of washing and sanitizing units, tanks, receivers, and pipelines to maintain a tight quality control on milk is essential.

b. Provide space in utility room for storing cleaning compounds and other supplies used in milking operation.

c. Store all articles off the floor on shelves.

d. Wash the udder with a warm sanitizing solution and dry with a single service paper towel.

e. Remove two or three streams of foremilk from each quarter and examine for abnormalities.

f. Dip the teats in a teat dip proved to be safe and effective immediately after the teat cups are removed.

g. Rinse milk solids from equipment (bulk tank, pipeline and milkers) with lukewarm water immediately after use.

h. Wash equipment with an alkaline detergent designed for the job and prepared according to manufacturer's directions.

i. Rinse detergent solution from equipment immediately after washing.

j. Treat equipment with an organic acid (milkstone remover) after detergent is rinsed off.

k. When cleaning equipment, the following should be observed:

(1) Do not mix alkaline detergent and organic acid.
(2) Do not mix chlorine sanitizer and organic acid.
(3) Do not soak inflations in chlorine solution.
(4) Do not scour equipment with steel wool or metal sponges.
(5) Do not expect to determine if equipment is clean by examining it when wet.
(6) Do not sanitize more than 30 minutes before equipment is to be used.

1.2.5 Follow recommended maintenance program.

a. Clean and maintain equipment properly, especially vacuum pumps, pulsator controls and inflations.

b. Have entire milking system analyzed twice a year by a qualified service representative.

c. Some companies offer a scheduled maintenance contract at a reasonable price.

1.2.6 Know how a milking machine works.

a. The following factors in milking machine construction and operation influence milking time:

(1) Vacuum level.
(2) Construction of teat cups.
(3) Weight of teat cup assembly.
(4) Weight of the suspended type of milker or tension of the unit and adjustment of mounting device.
(5) Rate and ratio of the pulsator.

b. Milk is removed from each quarter through the teat orifice by the vacuum acting on the end and side of the teat. Collapse and release of the teat cup liner does not squeeze out milk as in hand milking. The milking machine (as does a calf) sucks the milk out of the teat in intermittent strokes. By reducing pressure (a vacuum) outside the teat, the normal udder pressure forces the milk from the cow. Letting air into the teat cup shell periodically allows the inflation to collapse around teat and to supply the massage action so necessary to avoid congestion of blood in the teat walls which would occur with constant vacuum on the teat. The air is let into the teat in intermittent strokes by the pulsator.

c. The normal pulsator in a milking machine is a change-over valve which alternately connects the outer chamber of the teat cups to air and to vacuum. Meanwhile, the inside of the inflation is subject to continuous vacuum.

d. The purpose of letting in air is to cause the rubber walls of the inflation to massage the teats in an upward direction causing the blood to flow upward out of the teat. This counteracts the effect of the vacuum.

1.2.7 Analyze different chemicals for their effectiveness in cleaning and sanitizing.

Types of cleaners:

a. Alkaline cleaners - used to dissolve milk fats, proteins and carbohydrates and to loosen all soil particles not dissolved by water alone. These cleaners usually contain basic alkalines, phosphates, wetting agents and chelating agents.

(1) Basic alkalines - saponify fats.
(2) Silicates - protect soft or easily corrodible materials.
(3) Phosphates - precipitate minerals present in water.
(4) Polyphosphates - facilitate water softeners, free rinsers, emulsifies, dispersants, suspending agents; removal of proteins.
(5) Wetting agents - impart good rinsing properties to cleaning solutions.
(6) Chelating agents - prevent precipitation of minerals.

b. Chlorinated cleaners - alkaline cleaners with added chlorine; helps in removal of protein deposits and prevent formation of film; used in circulating cleaners.

c. Acid cleaners - mild food-trade organic and inorganic acids.

(1) Designed to prevent or remove mineral deposits.
(2) Not all-purpose cleaners.
(3) Soaps should not be used to clean dairy equipment. Insoluble curds are formed with hard water and leave greasy film difficult to remove.

1.3 Supplementary Materials

References: Managed Milking Guidelines for Maximum Return in Dairying.

1.4 Check-Out Activities

a. Visit a local dairy with the class and use "Good Milking Procedure Scorecard" found in Quality Milk Production, p. 40, to check students out.

b. Provide students with the following exercise:

1. Milking system not in good condition may cause mastitis in milking herd. T F

2. Milking at 15 inches vacuum is better than 12.5 inches vacuum on cow's teats. T F

3. Teats should be dipped in an approved teat dip immediately after each milking. T F

4. Alkaline detergents and organic acids are most effective if mixed before using. T F

5. Milk is squeezed out of cow's udder by a milking machine very much as done by hand milking. T F

6. Student will describe 5-3 test.

ANSWERS:

1. True
2. False
3. True
4. False
5. False
6. Hook up units as during milking. Allow air in one of the teat cups for five seconds, then drop teat cup to normal position. The vacuum drop should recover in three seconds. If it doesn't, either the vacuum pump is inadequate, the vacuum lines are too small, or a constriction may be present in the line or regulator.

## 2. PROVIDING AN ADEQUATE AND ECONOMICAL MILK HANDLING SYSTEM

### 2.1 Performance Objective

Given two written check-out activities concerning providing an adequate and economical milk handling system, the student will complete the check-out with 80 percent accuracy on each activity.

### 2.2 Teaching-Learning Activities

a. This section on providing an adequate and economical milk-handling system can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take one or more field trips to inspect adequate and economical milk-handling systems.

c. Use University of Kentucky Extension specialists or milking equipment company representatives.

2.2.1 Operate milking system economically.

a. In a milking parlor one milker should normally handle no more than three units; however, four units may be used by a very good milker.

b. When the milking parlor is equipped with automatic milking units, one operator should handle no more than six units.

c. All parts of a milk system including vacuum regulators, pulsators, pumps and reserve tanks and milking system should be compatible in regard to size, serviceability, repair, etc.

2.2.2 Maintain milking equipment properly (See Preventive Maintenance Guide, p. 16, 17, 18, 19).

a. During each milking:

(1) Check all rubber goods for breaks, tears, or water in shells; replace when necessary.
(2) Make sure pulsators are operating (check operation of inflation with thumb or finger) and that air bleeder units are open and clean.
(3) Check vacuum level.
(4) Empty trap; check belt tension and oil supply in vacuum pump.
(5) Make sure milk releaser or pumping equipment is operating and that line joints are tight.
(6) Make sure cleaned-in-place (CIP) equipment is properly detached or capped off.
(7) Check receiver jar probes for cleanliness.

b. After 50 hours of service:

(1) Inspect and change inflations (every 1,500 cow milkings).
(2) Check pulsator filters and clean or replace them.
(3) Clean vacuum controller and moisture drain valves.
(4) Clean and brush all air tubes.
(5) Fill oil reservoir on vacuum pump and check tension on vacuum pump belts.
(6) Perform additional preventive maintenance according to manufacturer's recommendations.

2.2.3 Supply adequate and stable vacuum for milking.

a. Size of vacuum and milk lines must be correct if the vacuum pump is to move air fast enough to prevent vacuum fluctuation at teat end.

b. Number of milking units the system can handle satisfactorily depends largely on diameter of vacuum and milk lines.

c. Check manufacturer's recommendations on each installation.

2.2.4 Maintain proper sanitation program.

a. One of the major causes of high bacteria counts in farm milk is a dirty milking machine.

b. Cleaners are not sanitizing agents. A sterilizing agent destroys all types of micro-organisms leaving a sterile surface. The function of a cleaner is to remove soils on equipment surface.

c. Types of cleaners:

(1) Alkaline.
(2) Chlorinated.
(3) Acid.

d. Factors affecting effectiveness of cleaners:

(1) Concentration - use according to manufacturer's recommendations.
(2) Temperature of cleaning solution - hot water should be 160° to 170° F and should be maintained at this temperature until wash cycle is complete.
(3) Contact time - allow sufficient time for cleaner to contact soils.
(4) Application of cleaners - post cleaning procedures so milkers know types and amounts of cleaners to be used; cleaning program must be organized to combat organic soils and control mineral deposits.

e. Types of sanitizers:

(1) Chlorine compounds.
(2) Iodine compounds.
(3) Quaternary Ammonium compounds.
(4) Acid wetting agents.

2.2.5 Produce milk that meets or surpasses quality standards.

a. The following laboratory tests are run to insure quality milk:

(1) Somatic cells.
(2) Bacteria.
(3) Antibiotics.
(4) Other adulterants including added water.

b. The following tests are used to detect mastitis:

(1) Physical examination of udder by palpating.
(2) Strip cup.
(3) California Mastitis Test (CMT) - screening test for each cow.
(4) Wisconsin Mastitis Test (WMT) - designed for use in laboratory on tank milk or blended milk.
(5) Direct Microscopic Cell Count (DMSCC).

c. Dipping teats in a specially prepared teat dip solution after milking is the most important single factor in milking procedure for preventing new mastitis infections.

d. Follow label directions and discard milk following any method of treatment in the udder, uterus, bloodstream or muscle, or oral administration if drug residues are to be avoided. Follow directions on antibotic drug labels to avoid selling cull cows that may contain drug residue which will be used for human consumption.

e. In general, flavor of milk cannot be improved upon. However, detrimental flavors can be added by the way milk is handled.

2.2.6 Operate equipment to cool milk properly.

a. Second to improper cleaning, the most common source of high bacterial count is improper cooling.

b. Warm milk is an excellent growth medium for bacteria.

c. Milk should be cooled to 50°F within the first hour and 40°F within the second hour to minimize bacterial growth.

d. Milk added at later milkings should not raise the temperature of total milk in the bulk tank to above 45°F.

e. Recording thermometers on bulk coolers are an effective management tool.

f. Check the bulk tank regularly to be sure it is cooling milk quickly and keeping it cool.

g. Keep milk in the bulk tank no longer than two days.

h. Do not rinse the top of the bulk tank while there is milk in it. Use a paper towel.

i. Draw milk from the outlet valve. Do not dip into the top of the tank.

j. Freezing and thawing milk tends to create rancid flavors. If warm milk is added to a layer of ice milk, milk molecules are broken down and milk will begin turning rancid.

2.2.7 Determine best milking system for each specific situation.

a. See table on manufacturer's recommendations for milking machine operation, page 12, Managed Milking Guidelines. The following brands are compared: Bou-Matic, Chore Boy, Conde, DeLaval, Sta-Rite, Surge, Universal, and Zero (see Milking Parlor Comparisons, pp. 22, 23).

2.2.8 Select milking equipment.

See table on "Manufacturer's Recommendations for Milking Machine Operation," page 12, Managed Milking Guidelines.

2.2.9 Compare pipe line systems.

Two types of pipe lines are needed in pipe line system:

a. A vacuum or pulsator pipeline carries air from pulsator to vacuum supplier.

b. A sanitary or milking pipeline is also a source of milking vacuum.

2.2.10 Design milk house arrangement for efficient work routine.

a. There are several popular milking systems (see UK Fact Sheet, Milking Parlor Systems):

(1) Herringbone.
(2) Tandem.
(3) Rotary.
(4) Stanchion Barn.
(5) Polygon.

b. Advantages of the herringbone system:

(1) Efficiency in moving cows in and out of parlor in groups.
(2) Diagonal, overlapping spacing of cows means fewer steps between cows and easier observation of progress of milking.

(3) Allows very efficient space utilization. Most compact of all parlor systems.

c. Advantages of tandem parlor milking:

(1) Each stall is a complete unit and can be arranged in any desired pattern--single row, v-shaped, or double row, left or right hand.
(2) Need to buy only number stalls required by herd size. More stalls may be added anytime.
(3) Individual handling of each cow possible.

d. Advantages of rotary milking parlor:

(1) With one entrance and one exit, traffic patterns are easiest of all milking arrangements.
(2) Gives optimum labor efficiency. Cow moves away from operator and another cow comes in position.
(3) Facilitates compact space requirement.
(4) Ratio of cows milked per man hour among best of all parlor arrangements.
(5) Is one of the most pleasant facilities to milk cows; less stress on operator, permitting a better job.

e. Ways to increase milking parlor efficiency:

(1) Limit grain feeding in parlor - completing rations fed outside parlor saves routine time.
(2) Use of crowd gate - device is used to encourage cows to enter parlor.
(3) Automatic udder washing - done in prep stalls before entering the milking stalls.
(4) Elimination of machine stripping - most cows will milk out with little or no machine stripping.
(5) Use of automatic detachers.
(6) Use of mechanically operated gates and doors.

2.2.11 Compare and select milk-cooling system.

a. Air-cooled condensing units for milk-cooling tanks should be sized to cool milk to meet standards plus allowance for heat gain and reduced efficiency during life of equipment.

b. Heat exchanger units (tube coolers) are being used by many dairies to help cool the milk while simultaneously heating the water. Considerable savings can be realized in both milk cooling and water heating.

2.2.12 Determine if a pipeline or transfer system is needed.

a. Milking pipeline must be installed on a continuous slope of 1 to 1½ inches per 10 feet of length.

b. Maximum distance of pipe from cow platform should be seven feet.

c. Line should slope toward milk receiver by gravity from milk inlet ports without flooding.

d. Risers in milk lines should be avoided since they contribute to development of rancidity and cause vacuum fluctuations.

e. In new construction it may be best to slope parlor floors toward milk room in order to keep milk lines as low as possible.

2.3 Supplementary Materials

References: 1. Managed Milking Guidelines for Maximum Return in Dairying.

2. Quality Milk Production.

2.4 Check-Out Activities

a. Visit local dairy with class and use dairy management checklist, "Milking System" in Quality Milk Production, pp. 74-75.

b. Provide students with the following exercise:

1. In a milking parlor one milker should normally handle no more than three units. T F

2. It is important that parts of a milk handling system be compatible. T F

3. A major cause of high bacteria counts in farm milk is _____.

4. Most cleaners are good sanitizing agents. T F

5. Temperature of cleaning solutions should be 160° to 170°F. T F

6. The top of the bulk tank should be rinsed each time milk is added. T F

7. An advantage of the rotary milking parlor is that it is the most pleasant facility in which to milk cows. T F

8. Milk lines should be installed as high as possible so they will be out of the way at all times. T F

ANSWERS:

1. True
2. True
3. dirty milking machines
4. False
5. True
6. False
7. True
8. False

## 3. PROVIDING ADEQUATE AND ECONOMICAL HOUSING FOR DAIRY ANIMALS

### 3.1 Performance Objective

Given two written check-out activities concerning providing adequate and economical housing for dairy animals, the student will complete the check-out with 75 percent accuracy on each activity.

### 3.2 Teaching-Learning Activities

a. This section on providing adequate and economical housing for dairy animals can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take a field trip to one or more good examples of adequate and economical dairy housing.

c. Use resource persons such as University of Kentucky Extension specialists or outstanding dairy farmers.

3.2.1 Provide adequate ventilation through fans, intakes, etc.

a. A warm barn is usually preferred for more than 10-15 calves. Maintain temperature between 40° and 50° F. Walls should have insulating value of R10 to R12. Ceilings should have insulating value of R18 to R20. Calf area should be partitioned off from milking herd so adequate conditions can be maintained for small animals. Individual calf hutches and naturally ventilated calf barns are preferred in Kentucky. They allow a calf to adjust to the environment much better than the dairy farmer can adjust it. The individual hutches also help eliminate the spread of contagious diseases and are very economical to construct.

b. Ventilate calf barn in the winter at 1/10 cubic foot per minute (c.f.m.) per pound of calf or two air changes per hour. Summer ventilation should provide 30 air changes per hour.

c. To maintain desirable inside temperature of about 50° in a calf barn, more heat may be needed than the animals provide.

d. Most controlled environment dairy buildings are kept 45° to 60°F from November through April. Relative humidities from 60 percent to 80 percent are common in ventilated dairy barns.

e. Ventilate the milk room with a 1,000 c.f.m. intake fan located on the cleanest and most dust-free side of the building. An exhaust fan should also be used. For summer ventilation, use fans of 12 or more air changes per hour capacity.

3.2.2 Maintain adequate maternity and hospital area.

a. One maternity pen should be provided for each 20 cows. Pen should be 100 square feet for Jerseys and 120 square feet for Holsteins. These should be used only when a clean, shady sod is not available and when weather dictates inside calving.

b. Facilities should be provided for veterinarians and A.I. technicians to work with cows and for clean-up.

3.2.3 Maintain good environment for dairy animals.

a. There is no change in production for Holsteins at 10° to 70° F, but there is a decline in production over 75°F. Jersey cows show no change between 30°F and 80°F with declines above and below these temperatures.

b. Smell is the best check of a calf facility for ventilation. If the calf barn smells like a calf barn, more ventilation is needed. A well-ventilated calf barn will not have an offensive odor.

3.2.4 Group calves according to size after weaning.

a. Calves should be individually housed until after weaning.

b. Group calves no more than six calves per pen with maximum age difference of one to two months.

c. Group pens should allow 15 to 20 square feet per calf. Calves 1½ to 10 months need 30 to 40 square feet per calf.

d. Calves should not be turned on pasture until six months of age.

3.2.5 Determine ventilation needs of dairy building.

a. Good ventilation does the following:

(1) Controls condensation on walls and ceilings.
(2) Removes foul air, gases, and moisture.
(3) Distributes fresh air through the building without harmful drafts.
(4) Reduces wide temperature fluctuations that reduce production.

b. During the summer months, ventilation systems must be capable of moving large quantities of air to control temperatures. A much smaller quantity of air must be moved during winter months to control humidity and moisture levels.

c. A complete ventilation system has three basic components:

(1) Fans to remove the required amount of air.
(2) A good air distribution system.
(3) Proper thermostatic controls.

d. Size of air inlets is critical for controlling air movement and drafts inside a barn. Cold barns should have a ridge vent and open eaves.

e. Provide one square foot of inlet per 1,000 c.f.m. fan capacity.

3.2.6 Keep housing in good repair.

The following are some items checked by milk inspectors in a milking barn, stable, or parlor:

a. Floors, gutters and feed troughs in good repair.

b. Walls and ceilings smooth, painted and finished adequately and in good repair.

c. Proper ventilation; no overcrowding.

d. Cow yard clean; cattle housing areas properly maintained.

3.2.7 Use individual calf pens for baby calves.

a. Loose run pens for individual young calves should be 15 to 20 square feet in size.

b. Grouping calves is not recommended until they are weaned or after first six weeks; then group in small groups of seven or less.

c. Clean, dry, draft-free environment should be provided new-born calf.

d. Facilities should be designed for easy cleaning and sanitizing.

e. Individual stalls are best for baby calves up to six to eight weeks.

3.2.8 Determine housing requirements for animals of different ages.

a. Many types of housing are used for baby calves. All good systems include four principles:

(1) Low stress with comfort for the calf.
(2) A dry floor on which calf may stand or lie.
(3) Good ventilation with no drafts.
(4) Low humidity; no condensation of moisture on walls or ceilings.

b. Individual tie stalls 2 feet by 5 feet may be used until weaning.

c. Loose-run pens for individual young calves should be 15 to 20 square feet in size.

d. Grouping calves is not recommended until they are weaned.

e. Group pens should allow 15 to 20 square feet per calf. Group no more than six calves per pen with maximum age difference of one to two months.

f. Calves 1½ to 10 months need 30 to 40 square feet per calf.

g. Heifers from 10 months to freshening are normally provided separate loose housing.

h. All pens should have moveable or swinging partitions so manure can be removed by machine.

3.2.9 Provide sufficient and low cost housing for dairy replacements.

a. Number of individual calf pens should be 20 to 30 percent of the milking herd if only heifers are raised or about 50 percent if all calves are raised.

b. Make-up of numbers in herd should be:

(1) Milking herd, 45 percent.
(2) Dry cows, 10 percent.
(3) Young stock (10 months to freshening), 24 percent.
(4) Heifers (6-10 months), 13 percent.
(5) Calves (under 6 weeks), 8 percent.

3.2.10 Develop plans for new dairy facilities.

a. Seek competent help in planning new construction and farmstead layout. Visit other farms for ideas.

b. Plan the new setup so further expansion can be made if desirable.

c. After all decisions are made and before starting construction, get approval from health and marketing authorities.

d. Facilities will include: housing, milk handling, feed storage, feeding, and manure-handling facilities.

3.2.11 Layout plans for improving existing facility.

a. Dairy farmers nearing retirement age with no sons or daughters to assume control of the business should seldom consider large scale expansion.

b. Alternatives to be considered for dairy farmers expecting to remain in dairying for another 10 years or more:

(1) New investments should be such that they can be recovered preferably in 5 years, but not more than 8 to 10 years.
(2) With large scale expansion (up to 100 cows or more), one cannot afford serious mistakes. Keep investments as low as possible and make mistakes on paper first.

3.2.12 Analysis of different systems of dairy housing.

a. Housing definitions:

(1) Cold housing - means cold in winter. It is designed to use natural air movement to keep inside temperatures within a few degrees of outside conditions.
(2) Warm housing - means warm in winter. It is designed to use fans to provide air movement, at least in winter. Insulation helps retain animal heat to keep inside temperatures above 45° in winter.
(3) Stanchion barn - each cow is tied in a stanchion, tie stall, or comfort stall.
(4) Loose housing - cows are free to move between resting, feeding and watering areas. Cows rest in free-stalls or loafing sheds. Free-stall housing is the most popular housing for people starting into the dairy business today. The advantages and disadvantages follow.

b. Advantages of free-stall housing:

(1) Reduced bedding requirement - saving of 75 percent or more.
(2) Cleaner cows - less udder washing before milking.
(3) Higher quality milk - less sediment.
(4) Less space required per cow - 50 square feet vs. 70 square feet for loose housing.
(5) Less udder injury - cows separated by stall dividers.
(6) Less peak labor load in spring.

c. Disadvantages of free-stall housing

(1) Some cows ( up to 10 percent and especially older ones) may refuse to use the stalls.
(2) Semi-liquid manure hard to handle with conventional equipment. A liquid manure handling system is a big investment.
(3) More daily labor, depending on total system.
(4) A free stall resting area costs more than a conventional open resting area.

3.3 Supplementary Materials

References: 1. Dairy Housing and Equipment Handbook.

2. Plans for Dairy Buildings and Equipment.

3.4 Check-Out Activities

a. Visit local dairy with class and use dairy management checklist, "Housing," p. 73, Quality Milk Production.

b. Provide students with the following exercise:

1. In a calf barn in the summer, the air should be changed about five times per hour. T F

2. Maternity pens should be used whenever possible. T F

3. Most cattle show no decline in milk production with temperature fluctuations between 30° and 70°. T F

4. Calves should be individually housed until after weaning. T F

5. All good calf housing includes the following four principles:

   a.
   b.
   c.
   d.

6. All pens should have movable or swinging partitions so manure can be removed by machine. T F

ANSWERS:

1. False
2. False
3. True
4. True
5. a. low stress; b. dry floor; c. good ventilation; and, d. low humidity
6. True

## 4. PROVIDING ADEQUATE AND ECONOMICAL MATERIALS HANDLING EQUIPMENT

### 4.1 Performance Objective

Given a written check-out activity concerning providing adequate and economical materials handling equipment, student will complete the activity with 80 percent accuracy.

### 4.2 Teaching-Learning Activities

a. This section on providing adequate and economical materials handling equipment can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take a field trip to visit various kinds of materials-handling equipment.

c. Use slides of materials-handling systems to point out advantages and disadvantages of each.

d. Take students to the National Farm Machinery Show in Louisville to see materials-handling equipment.

4.2.1 Make necessary improvements in manure-handling system.

a. The problems of runoff from cropland, feedlots and barnyards are ones dairy farmers, as well as all farmers, will be hearing more about in the future.

b. The Federal Clean Water Act Amendments of 1972, Section 208, is changing the way dairy farmers handle runoff. It controls non-point (does not come out in a single point such as a drain pipe) sources of pollution in streams.

c. Best management practices on handling animal waste call for limiting access of herds to waterways, constructing dams to prevent runoff from barnyards and feedlots, constructing special waste retention facilities and changing application techniques and times.

d. Pollution control facilities eligible for investment credit under 1978 Revenue Act are:

(1) Runoff holding ponds.
(2) Dewatering systems (irrigation) for runoff disposal.
(3) Evaporation ponds.
(4) Lagoons for manure treatment.
(5) Lagoon aerators.
(6) Manure storage pits - external and underfloor.
(7) Hydraulic flush systems.
(8) Liquid manure pumps.

(9) Conveyance channels and pipelines.
(10) Manure collection equipment.
(11) Manure hauling/spreading equipment.
(12) Dead animal incinerators.
(13) Fly control sprayers.
(14) Fences surrounding pollution control facilities.
(15) Buildings housing pollution control equipment.

4.2.2 Plan labor-saving chore routine.

a. Silos should be placed for convenient access for filling and removing feed.

b. Feed rooms for storage of concentrates with carts may be used if automatic feeding equipment is not used.

4.2.3 Provide manure-handling system.

a. Some types of manure-handling systems are:

(1) Tractor scraping - scraping with a blade or bucket on a tractor.
(2) Automatic scrapers - alley scrapers may discharge into cross-conveyor for transporting outside to storage or liquid spreader.
(3) Flush system - stored water is released under pressure in an explosive torrent to flush parlor holding areas.
(4) Liquid manure storage - manure pits located away from housing area rather than under it are recommended. Milk center wastes also are added in this storage.

b. Manure-handling facilities may be classified into two types of systems:

(1) Solid waste handling - use stacking, daily hauling.
(2) Liquid waste handling - slotted or solid floors, tanks, lagoons.

c. Of all materials handled in a dairy operation, animal waste is the largest single item.

d. Estimated cost of changing to liquid manure handling is $50 to $100 per head initially when system is used to capacity.

e. Some factors to consider in dairy waste disposal:

(1) Number of cows per acre of land.
(2) Crop rotation, affecting acreage on which manure can be spread each month.
(3) Topography of land.
(4) Possibility of stream pollution.
(5) Nearness of farm to towns and/or suburban areas.

f. Recent changes in housing places more cows in unbedded paved lots, feeding areas, holding pens, eliminating bedding in the manure.

g. If manure is not liquid enough, water must be added to make it pumpable or to the stage that it will flow by gravity.

h. Liquid manure is transported to field in tanks ranging from 700 co 2,000 gallons. This requires a large tractor.

i. Flail type spreaders are dual purpose that handle either liquid or solid manure; may be loaded with pumps or tractor-mounted buckets.

j. Most solid manure is still handled in conventional spreaders, loaded by tractor-mounted loaders or, in some cases, a gutter cleaner.

k. Stock piling manure for later disposal is necessary in both liquid- and solid-handling systems.

4.2.4 Evaluate present manure-handling system.

Consider the following:

a. Is animal waste managed so that it will not contribute to water and air pollution and fly and rodent problems?

b. Compare cost of bedding and handling waste as solids with changing to liquid manure handling.

4.2.5 Calculate amount of storage needed annually.

a. Size of stockpile for solid or liquid material depends on:

(1) Number and size of animals.
(2) Length of time manure is to be stored.

b. Storage capacity for liquid manure tanks should provide two or more cubic feet per cow per day.

c. Most liquid storage tanks have capacity for 30 or more days to allow for periods when it is inconvenient to haul.

d. Solid manure storage (either pit or above ground) should provide 15 or more square feet of well-drained area per cow.

e. Most soil types can receive about 30 tons (wet) of livestock wastes per acre per year without danger of depressing crop production or causing ground water pollutions.

f. A 1,200-pound dairy cow produces 15 tons of waste per year, requiring one-half acre for disposal.

4.2.6 Compare methods of manure disposal.

a. Some commonly used methods of manure disposal and their advantages:

(1) Surface application - immediate spreading results in less loss of nutrients.
(2) Anaerobic lagoon:

(a) Lower initial investment than liquid manure system with field spreading.
(b) Low labor requirement.
(c) Fly problem eliminated or reduced.

(3) Aerobic lagoon:

(a) Oxygen supplied by algae or some type of mechanical aerator.
(b) Treated manure (effluent) can be discharged in stream.
(c) No offensive odor is produced.

(4) Oxidation ditches:

(a) Used mostly in cold climate.
(b) Little or no odor.
(c) Effective in cold climates.

(5) Stacking - impoundment area can be built without great expense.
(6) Dehydration - water content reduced from 85 percent to 15 percent allows material to be handled in very dry condition.
(7) Composting - final product has low moisture content and may be marketed as fertilizer or used for field spreading.
(8) Refeeding - feed nutrient fed back to livestock allows a possible economic return by supplementing feed and also provides a means of disposal.

b. Some commonly used methods of manure disposal and disadvantages:

(1) Surface application:

(a) Requires good management and an economic and labor investment.
(b) Because of rain or freezing weather, spreading is prevented and additional storage is sometimes needed.

(2) Anaerobic lagoon:

(a) Disagreeable odor is produced.
(b) Decomposition is incomplete, leaving sludge.
(c) Removal is required.
(d) Mosquito habitat is provided.
(e) Ground water pollution more likely than with surface application.

(f) Fertilizer value may be lower than direct surface application.
(g) Cannot discharge excess into stream; excess land must be provided.

(3) Aerobic lagoon:

(a) Requires very large land area or mechanical agitators.
(b) Periodic sludge removal required and mosquito habitat provided.
(c) Frequently unsuccessful because of heavy quantities placed in them.

(4) Oxidation ditch - cost generally too high.
(5) Stacking:

(a) Much nutrient content lost.
(b) Pollution may be caused.
(c) Problem in inclement weather.

(6) Dehydration:

(a) Relatively high nutrient loss.
(b) High energy requirements for drying.

(7) Composting:

(a) High labor requirements.
(b) Some odor problems.
(c) High energy requirements.
(d) Market may be difficult to find.

(8) Refeeding:

(a) Suitable collection facilities must be developed.
(b) Lack of acceptance due to aesthetic and health conditions.

4.3 Supplementary Materials

Reference: Livestock Waste Management.

4.4 Check-Out Activities

Provide students with the following exercise:

1. Three of the pollution control facilities eligible for investment credit under the 1978 Revenue Act are: (1) evaporation ponds, (2) lagoons for manure treatment, and (3) lagoon aerators. T F

2. Manure-handling facilities may be classified into two types of systems:

   a.
   b.

3. The estimated cost of changing to a liquid manure-handling system when used to capacity is about $300 to $500 per head initially. T F

4. Recent changes in housing eliminates bedding in the manure. T F

5. Large amounts of oxygen are required for anaerobic lagoons. T F

6. Refeeding is considered objectionable because of aesthetic and health conditions. T F

7. A 1,200-pound dairy cow produces 15 tons of waste per year and this would require one-half acre for proper disposal. T F

ANSWERS:

1. True
2. a. solid waste; b. liquid waste
3. False
4. True
5. False
6. True
7. True

## LIST OF RESOURCES

### Books

Dairy Cattle Science, 1st ed., M. E. Ensminger. The Interstate, Danville, Illinois, 1971. 524 pages.

Dairy Production, 4th ed., Ronald V. Diggins, Clarence E. Bundy, and Virgil W. Christensen. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1979. 326 pages.

Harvesting Your Milk Crop, Charles W. Turner. Babson Bros. Dairy Research and Education Service, Oak Brook, Illinois, 1962 Revised. 76 pages.

Principles of Dairy Science, 1st ed., G. H. Schmidt, L. D. VanVleck. W. H. Freeman and Company, San Francisco, California, 1974. 558 pages.

The 1969 Agricultural Engineers Yearbook. The American Society of Agricultural Engineers, Box 229, St. Joseph, Michigan 49085. 1969.

### Other Publications

A Guide to Understanding Quality Milk Production, Nelson Philpot and H. E. Randolph. Tuco Division of the UpJohn Company, Kalamazoo, Michigan 49001, 1977. 19 pages.

*An Effective Mastitis Control Program, William L. Crist and Gary T. Lane. University of Kentucky, Cooperative Extension Service, Lexington, Kentucky. 2 pages.

Bou-Matic Milking Systems. Dairy Equipment Co., Division of D.E.C. International, Inc., P. O. Box 1289, Madison, Wisconsin 53701. 22 pages.

*Cleaning and Sanitizing Dairy Utensils, James C. Hartley. University of Kentucky, Cooperative Extension Service, Lexington, Kentucky. 1973.

Considerations in Selecting Dairy Calf Housing, ID-93, N. J. Moeller and W. H. Friday. Purdue University, Cooperative Extension Service, West Lafayette, Indiana. 1973.

Dairy Farm Inspection Report, CHPS-77. Commonwealth of Kentucky, Department for Human Resources, Bureau for Health Services, Frankfort, Kentucky. 1976.

*Dairy-Feeding Dairy Heifers, ASC-20, Ron Wendlandt and Roger Hemken, University of Kentucky, Cooperative Extension Service, November, 1972. 2 pages.

Dairy Herd Management, Bulletin 515, Ralph Porterfield. Ohio State University, Cooperative Extension Service, Columbus, Ohio. 1970.

Dairy Housing and Equipment Handbook, 3rd ed. Midwest Plan Service, Iowa State University, Ames, Iowa 50011, 1978. 104 pages, price: $3.00.

*Dairy Milking Parlor Systems, ASC-24, John Nicholai and George Turner. University of Kentucky, Cooperative Extension Service, Lexington, Kentucky, 1974. 25 pages.

DeLaval Pocket Diary, For Dairy Professionals. The DeLaval Separator Co., Poughkeepsie, New York 12602. 1979.

Free-Stall Loose Housing for Dairy Cattle, ID-63, N. J. Moeller and J. R. Foley. Purdue University, Cooperative Extension Service, West Lafayette, Indiana, 1970. 4 pages.

*Feeding, Managing, and Vaccinating Dairy and Orphan Beef Calves From Birth to Weaning, ASC-30, John H. Nicolai, R. W. Hemken, Don LaBore, and Nelson Gay. University of Kentucky, Cooperative Extension Service, Lexington, Kentucky, 1975. 6 pages.

Housing for Dairy Replacements, Leaflet DG-505, H. B. Manbeck. Ohio State University, Cooperative Extension Service, Columbus, Ohio. 1978.

*Livestock Waste Management, AEN-44, Jerry P. Bowden. University of Kentucky, Cooperative Extension Service, Lexington, Kentucky, 1978. 5 pages.

Managed Milking Guidelines, G. M. Jones. Virginia Polytechnic Institute and State University, Cooperative Extension Service, Blacksburg, Virginia, 1974. Reprinted by BASF Wyandotte Corp., Wyandotte, Michigan.

*Mastitis Control Increases Dairy Production and Profits, ASC-53, John N. Nicolai, Jr., Bruce Langlois, Gordon Hess, and Roger Hemken. University of Kentucky, Cooperative Extension Service, Lexington, Kentucky, 1977. 4 pages.

Modern Dairying With Stall Barns, Booklet. Babson Bros. Co., 2100 S. York Road, Oak Brook, Illinois 60521, 1975. Price: $1.00.

*Planning Dairy Calf Housing, ID-15, G. A. Duncan, G. M. Turner, J. H. Nicolai, and D. E. LaBore. University of Kentucky, Cooperative Extension Service, Lexington, Kentucky, 1975. 7 pages.

*Plans for Dairy Building and Equipment, AEN-3. University of Kentucky, Cooperative Extension Service, Lexington, Kentucky, 1973. 5 pages.

*Proper Use of Milking Equipment - Teat Cup Operation and Use, Part I, Misc. 332, George M. Turner. University of Kentucky, Cooperative Extension Service. 6 pages.

Quality Milk Production, Teacher Education Series, Vol. 5, No. 2, Earl M. Gessler and Others. The Pennsylvania State University, Department of Agricultural Education, University Park, Pennsylvania 16802. 1972.

Quality Milk Production for High School Students, Teacher Education Series, Vol. 14, No. 15, James R. Curtis and Samual M. Curtis. The Pennsylvania State University, Department of Agricultural Education, University Park, Pennsylvania 16802. 1973.

Rules for Good Milking Techniques. National Mastitis Council, Inc., 910 Seventeenth Street, N. W., Washington, D.C. 20006.

Types of Milking Parlors, Leaflet DG-500, G. H. Schmidt. Ohio State University, Cooperative Extension Service, Columbus, Ohio, 1978.

*These are available free of charge from your county cooperative extension office or can be ordered in quantity (up to one per each two students in your largest class) through the Department of Vocational Education, University of Kentucky, Room 43 Dickey Hall, Lexington, Kentucky 40506.

Slides

Insulation of Livestock Building (24 slides with tape), Vernon M. Meyer, Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112. Price: $14.50.

Milk House Scorecard (34 slides), Agricultural Education Department (Prepared in conjunction with the Pennsylvania Farm Electrification Council), Pennsylvania State University, 101 Armsby Hall, University Park, Pennsylvania 16802. Price: $7.50.

Money Returns From an Effective Mastitis Control Program (47 slides with tape and script). Prepared by National Mastitis Council, Inc., 910 Seventeenth Street, N. W., Washington, D.C. 20006. Distributed by NASCO, Ft. Atkinson, Wisconsin 53538. Price: $25.00, Slides; $12.00, Filmstrip; $6.00, Cassette tape.

NMC Rules for Good Milking Techniques (24 slides with tape). Prepared by National Mastitis Council, Inc., 910 Seventeenth Street, N. W., Washington, D.C. 20006. Distributed by NASCO, Ft. Atkinson, Wisconsin 53538. Price: $12.00 with script.

8mm Film Loops

Good Milking Procedures. Hobar Productions, 1234 Tiller Lane, St. Paul, Minnesota 55112. Price: $29.00.